Worksheet 3 Karnaugh maps

Task 1

1. Fill in Karnaugh maps for the following expressions, showing the groupings by ringing them.

   In parts (d), (e) and (f), fill in the missing row and column labels.

   (a) A

   (b) ¬A ˄ C

BC A

	00	01	11	10
0				
1				

	00	01	11	10
0				
1				

(c) A ˄ ¬B

(d) B

(e) A ˄ B ˄ ¬ C

BC A

0				
1				

0				
1				

2. Fill in Karnaugh maps for the following expressions, showing the groupings. Hence simplify the expressions.

   (a) (A ˄ B) ˅ (A ˄ ¬C) ˅ (A ˄ ¬B)

   (b) (A ˄ B ˄ C) ˅ (¬A ˄ B) ˅ (A ˄ B ˄ ¬C)

BC A

(a)

	00	01	11	10
0				
1				

(b)

	00	01	11	10
0				
1				

3. Use a Karnaugh map to show that A ˅ ¬A ˄ B = A ˅ B.

   (You drew a truth table to prove this in Worksheet 2, Question 4)

B A

	0	1
0		
1		

Task 2

4. What Boolean expressions do each of the ringed squares in the Karnaugh map in Figure 1 represent?

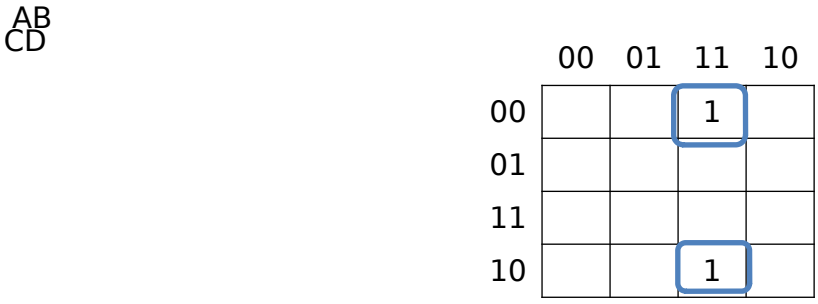

Figure 1

Row 1 column 3 =

Row 4 column 3 =

Write the Boolean expression represented by the map in its simplest form.

5. (a) Ring the two groups in Figure 2. What Boolean expression does this Karnaugh map represent?

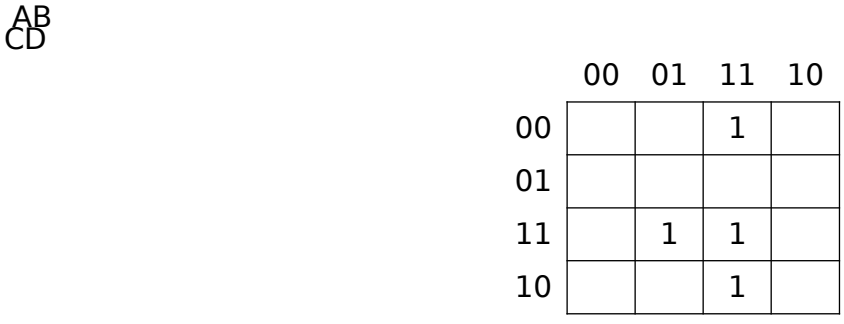

Figure 2

(b) Complete the Karnaugh map in Figure 3 to represent the expression:

(A ^ B ^ C ^ ¬D) ˅ (¬A ^ C ^ ¬D) ˅ (A ^ ¬B ^ C ^ ¬D)

Draw the resulting group(s) and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 3

(c) Complete the Karnaugh map in Figure 4 to represent the expression:

(A ^ B ^ C) ˅ (C ^ D) ˅ (A ^ ¬C) ˅ (A ^ ¬B ^ C ^ ¬D)

Draw the groups, and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 4

(d) Complete the Karnaugh map in Figure 5 to represent the expression:

(¬A ^ ¬B ^ ¬C^ ¬D) ˅ (¬A ^ ¬B ^ C ^ ¬D) ˅ (A ^ ¬B ^ ¬C ^ ¬D)

˅ (A ^ ¬B ^ C ^ ¬D)

Draw the group(s), and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 5

(e) Complete the Karnaugh map in Figure 6 to represent the expression:

(¬A ^ ¬B ^ ¬C^ ¬D) ˅ (¬A ^ ¬B ^ C ^ ¬D) ˅ (A ^ ¬B ^ ¬C ^ ¬D)

˅ (A ^ ¬B ^ C ^ ¬D) ˅ (¬B ^ D)

Draw the group(s), and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 6

7. How many squares in a Karnaugh map with 4 variables contain 1 when an expression containing only AND symbols has:

(i) 4 variables, e.g. (¬A ^ ¬B ^ ¬C^ ¬D)?

(ii) 3 variables e.g. (A ^ B ^ C)?

(iii) 2 variables, e.g. (¬B ^ D)?

(iv) 1 variable, e.g. A?